Relationship of Bone Marrow Density (Hip and Spine) in Cerebral Palsy: A Case-Control Study

Dr. Avikalp Prakash[1], Dr. Rajeswari Jindal[2] and Dr. Mrinal Joshi [3]

[1]Medical Officer, State Government of Rajasthan, Jaipur, (Rajasthan) India.
[2]Professor, Department of PMR, SMS Medical College, Jaipur, Rajasthan, India
[3]Senior Professor, Department of PMR, SMS Medical College, Jaipur, Rajasthan, India

Abstract— *Cerebral palsy (CP) is the most common physical disability of childhood. Children with CP frequently grow slowly and are more prone to fractures. So this study was aimed to explore relationship of bone mineral density (BMD) with cerebral palsy by case-control study. This study was conducted at Department of Physical Medicine and Rehabilitation of Sawai Man Singh Medical College, Jaipur. Hip bone and spine bone was used to assess BMD. Bone mineral density was measured by DEXA in both groups i.e. study group and control group after ensuring the comparability of both groups. Difference in means of BMD in both the groups was inferred by unpaired student's' test of significance. It was found in this study that bone mineral density of hip well as spine was significantly lowered in cerebral palsy cases.*

Keywords— Cerebral Palsy, Bone Mineral Density, DEXA

I. INTRODUCTION

Cerebral palsy (CP) is the most common physical disability of childhood.[1] Estimated prevalence of cerebral palsy is 2.5 per 1000 population. In recent years, the incidence rate of CP has been increasing internationally due to increased survival of low birth weight infants.[2] Most children with cerebral palsy are undernourished, while 8% to 14% are overweight.[3] The caloric intake of children with CP is lower than that of age-matched controls.[4] Gastroesophageal reflux affects a significant proportion of children with CP. [5] Frequent emesis and regurgitation may be a source of caloric loss. Reflux esophagitis may cause discomfort leading to food refusal and further decreasing food intake.[6]

Oromotor dysfunction affects upto 90% of patients with CP[7] and is a major contributor to malnutrition in children with CP.[8,9] Inadequate sucking, dysfunctional swallowing, persistent extrusion reflex, drooling due to inadequate lip closure and reduced ability to chew make oral feeding difficult.[9]

Children with CP frequently grow slowly. The impact of this altered growth on skeletal development and bone density is a significant health problem.[10] Vitamin D plays a role in bone mineralization by maintaining adequate levels of calcium and phosphorus in the blood. This allows the osteoblasts to lay down bone matrix. The production of 1, 25(OH) 2D is regulated by serum calcium levels through the action of parathyroid hormone (PTH) and phosphorus.[11]

In view of ambiguity of the factors influencing the skeletal maturation and mineralization in children with cerebral palsy and, due to paucity of studies from country this present study was conducted with the objective to assess and compare the bone mineral density in children with or without cerebral Palsy.

II. METHODOLOGY

This hospital based case control analytical type of observational study was conducted at Department of Physical Medicine and Rehabilitation, Sawai Man Singh hospital and Medical College and Attached Hospitals, Jaipur, Rajasthan between the period from May 2012 to November 2013.
It is a hospital based case control analytical type of observational study.

Sample size was calculated 31 subjects for each of the group at study power 80% and alpha 0.05 assuming 0.109 gm/cm2 difference of mean to be detected in bone marrow density with SD 0.150. So for the study purpose 35 cases and 35 matched controls were taken in this study.

For the study purpose every eligible case of cerebral palsy attending outdoor as well as indoor ward of the department, was included in study. Clinically diagnosed cases of cerebral palsy between 3 years to 14 years of age whose parents/primary caregiver were ready to give consent. Out of these, cases with hip implants and crush vertebra were excluded from study. Even cases who had significant medical/physical disabilities that interfere them in getting investigations (e.g. DEXA) were also excluded from study. Controls were selected by matching confounding factors and preference was given to other sibling.

After getting approval from the Ethical Committee of the S.M.S Medical College, this study was conducted at outdoor and indoor of Department of Physical Medicine and Rehabilitation. All cases of were assessed clinically by a detailed systemic and neurological examination along with general information about subjects. Every patient filled a detailed proforma with informed consent form about their physical therapy status, history of operations/ surgery or prolonged casting, and/or history of fracture. Use of antiepileptic drugs, calcium and energy intakes were also noted. Significant birth history was asked regarding mode of delivery, birth weight, birth order and/or any history of delayed cry, jaundice, seizure or cyanosis soon after birth. Socio-economic status was assessed by Kuppuswamy‘s Socioeconomic Status scale.

Bone mineralization of lumbar spine and upper end of femur of non dominant side were obtained in both the cases and control group in supine position by a dual energy x-ray absorptiometry (DEXA-Hologic). The bone mineral density (BMD) was measured in grams per unit area (cm2). DEXA is most widely used method for assessment of BMD and is considered the gold standard. Bone Mineral Density through DEXA scan was done for the every case and controls by same machine.

Statistical Analysis:

Data thus collected were entered in MS Excel 2007 worksheet in the form of master chart. Qualitative data are expressed in form of percentage and proportions and quantitative data are expressed in form of Mean ± SD. Significance of difference in proportion is inferred with Chi-Square test and significance of difference in means is inferred with Unpaired Student 't test using Primer of Biostatistics software version 6.0. For significance 'p' value <0.05 was considered significant.

III. RESULTS

In this present study majority of participants were in the age group of 5 to 10 years in both the groups. Although there were more participant in 0 to 5 years group in cases than controls (28% v/s 8.57%) but this difference in distribution of proportion as per age in both the group was not found significant (p= 0.083). Likewise age, although there was difference in M:F ratio in both groups i.e. 3.38 in cases and 1.5 in controls but this difference was also not found significant (p=0.198). When socio-economic status (SES) wise distribution was observed in this study it was found that although among cases maximum were in lower middle (III) followed by class II, class IV and class I whereas among controls cases maximum were in upper middle (II) followed by class III, class IV and class I but this difference in distribution of proportion as per SES in both the group was also not found significant (p=0.339). In this study, although rural cases are more than the controls (57.14% & 25.71%; cases and controls respectively) but this difference in distribution of proportion as per SES in both the group was also not found significant (p<0.05). So it is depicted that cases and controls were well comparable group (Table 1)

Table 1

Comparison of Socio-demographic Variables in cases and controls

Socio-demographic Variables		Cases (N=35)		Controls (N=35)		Chi-square P Value LS
		No	%	No	%	
Age	**0-5 Years**	10	28.57	3	8.57	4.989 at 2 DF; p = 0.083; **NS**
	5-10 Years	19	54.28	22	62.86	
	10-15 Years	6	17.14	10	28.57	
Sex	**Female**	8	22.86	14	40	1.657 at 1 DF; p = 0.189; **NS**
	Male	27	7.14	21	0	
Socioeconomic Status Scale (Kuppuswamy's)	**Upper (I)**	5	14.29	3	8.57	4.083 at 3 DF; p = 0.339; **NS**
	Upper Middle (II)	9	25.71	16	45.71	
	Lower Middle (III)	14	40	8	22.86	
	Upper Lower (IV)	7	20	7	20	
	Lower (V)	0	0	0	0	
Residence	**Rural**	20	57.14	9	25.71	5.887 at 1 DF; p = 0.055; **NS**
	Urban	15	42.86	26	74.29	

When bone mineral density was procured with the help of DEXA scan of hip and spine in this study. Mean Bone mineral density (BMD) of hip in cases was 0.46 ± 0.162 and that of controls is 0.642 ± 0.171. This difference in means in both the group was found highly significant ($p<0.001$). Likewise mean BMD of spine in cases is 0.488 ± 0.126 and in controls it is 0.622 ± 0.155. This difference in means in both the group was found highly significant ($p<0.001$). These observations revealed that there is BMD is significantly lower in cases than controls. (Table 2)

Table 2

Comparison of Bone Mineral Density in cases and controls

S. No.	**Bone Mineral density (gm/cm^2)**	**Cases (N=35) (Mean ± SD)**	**Control (N=35) (Mean ± SD)**	**Unpaired Student 't' test P Value LS**
1	**Hip**	0.46 ± 0.162	0.642 ± 0.171	**-4.511 at 68 DF P<0.001 S**
2	**Spine**	0.483 ± 0.126	0.622 ± 0.155	**-4.117 at 68 DF P<0.001 S**

IV. DISCUSSION

One of the most important medical problems of severely retarded and physically challenged children is the risk of pathological fractures due to inadequate mineralization [21].[12] This present study is to explores the association of bone mineral density (BMD) with cerebral palsy. Both, cases and control groups were well comparable. When bone mineral density was assessed with the help of DEXA scan of hip and spine in this study, it was revealed that BMD is significantly lower in cases than controls.

The mean age of the cases was 7.68±2.96 years while 9.05±2.82 years in controls group. (p – Value >0.05). Most of the participants belonged to 5 – 10 years age group. There were male predominance in both the group. In cases around 77% and in controls 60% were males. According to Kuppuswamy's socioeconomic status cases were most of the participants were from upper middle and lower middle class. There was no participant belonged to lower (V) class of socioeconomic status. All these data having no significant differences in cases and control group (p >0.05). So groups were well comparable.

In the present study the overall BMD of cases was 0.46±0.162 for hip and 0.483±0.126 for spine while in controls it was observed 0.642±0.171 & 0.622±0.155 respectively. In both places (hip & spine BMD was significantly lowered in cases group that controls.

When BMD of cases in different age group was compared with controls it had shown a variable pattern for hip and spine. In BMD hip, there was no significant differences in 0 – 5 years and 5 – 10 years group and significant (<0.05) differences in 10 – 15 years group. While in BMD spine, there were significant values for in 0 – 5 years and 5 – 10 years group and non significant value for 10 – 15 years group. The reason remains unclear. In all the groups and all the sites measured by DEXA, there was definitely lesser bone mineral density in the study group than the controls group which was quite similar to study conducted by K. E. Chad et al (2000) [70].[13] To the contrary, Henderson et al[14] [71] and Joan Jasien and colleagues[15] [29] stated that in severe cerebral palsy there had been shown to be a relationship between advancing age and declining BMD Z – scores. The differences in these studies might be due to cases in present study who were more ambulatory than the other studies which had discussed about spastic quadriplegia.

V. CONCLUSION

It was found in this study that bone mineral density of hip well as spine was significantly lowered in cerebral palsy cases.

CONFLICT OF INTEREST

None declared till now.

REFERENCES

1. Rosenbaum Peter, N. Paneth, "Definition and Classification of CP April 2006 PeterRosenbaum," Dev Med Child Neurol, vol. 109, pp. 8-14, 2007.
2. Colver A. F., Gibson M, Hey EN, "Increasing rates of cerebral palsy across the severity spectrum in north-east England 1964-1993," Arch Dis Child Fetal Neonatal Ed. , vol. 83(1), p. F7–F12, Jul. 2000.
3. A Riley, C Vadeboncoeur, "Nutritional differences in neurologically impaired children," Paediatr Child Health, vol. 17(X), pp. 98-101, 2012.
4. Reilly S, Skuse D, "Characteristics and management of feeding problems of young children with cerebral palsy," Dev Med Child Neurol, vol. 34, pp. 379-88, 1992.
5. P. B. Sulivan, Feeding and Nutrition in Children with Neurodevelopmental Disability. John Wiley & Sons, Jul-2009.

6. L. B. Joan C. Arvedson, Pediatric Swallowing and Feeding: Assessment and Management. Cengage Learning, 2002.
7. Reilly S, Skuse D, Poblete X, "Prevalence of feeding problems and oral motor dysfunction in children with cerebral palsy: a community survey," J Pediatr., vol. 129(6), pp. 877-82, Dec.
8. Fung EB, Samson-Fang L, Stallings V A, "Feeding dysfunction is associated with poor growth and health status in children with cerebral palsy," J Am Diet Assoc, vol. 102, pp. 361-73, Mar. 2002.
9. Motion S, Northstone K, Emond A, Stucke S, "Early feeding problems in children with cerebral palsy: weight and neurodevelomental outcomes," Dev Med Child Neurol, vol. 44, p. 403, 2002.
10. Christine Murray Houlihan, Richard D Stevenson, "Bone Density in Cerebral Palsy," Phys Med Rehabil Clin Am., vol. 20(3), pp. 493-508, Aug. 2009.
11. Peter Burckhardt, Bess Dawson-Hughes, Robert P. Heaney, Nutritional Aspects of Osteoporosis, 2nd ed. San Diego, US: Elselvier, 2007.
12. Shaw NJ, White CP, Fraser WD, Rosenbaum L, "Osteopenia in cerebral palsy," Arch Dis Child, vol. 71, pp. 235-238, 1994.
13. K E Chad, H A McKay, G A Zello, "Body composition in nutritionally adequate ambulatory and non-ambulatory children with cerebral palsy and a healthy reference group," Dev Med Child Neurol, vol. 42, pp. 334-339, 2000.
14. Henderson RC, Gilbert SR, Clement ME et al, "Altered skeletal maturity in moderate to severe cerebral palsy," Dev Med Child Neurol, vol. 47, pp. 229-36, 2005.
15. Joan Jasien, Caitlin M D, Stuart M, Bruce K S et al, "Aging and one health in individuals with developmental disabilities," International Journal of Endocrinology, vol. 2012, p. 10, 2012.